Transventricular, transaqueductal scope-in-scope endoscopic excision of fourth ventricular neurocysticercosis: a series of 13 cases and a review

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Object. Neurocysticercosis (NCC) is the most common parasitic infestation of the central nervous system worldwide. In patients presenting with acute hydrocephalus due to intraventricular NCC, surgery is the only option. Still, there is no consensus regarding the optimal surgical strategy, although neuroendoscopic excision is a promising method. However, the literature regarding the use of this modality in fourth ventricular NCC is scarce. The authors describe a series of patients with fourth ventricular NCC treated endoscopically.

Methods. The clinical records of 13 patients with fourth ventricular NCC who had presented with hydrocephalus were retrospectively analyzed. A fourth ventricular cyst was completely excised in all patients by using a transventricular, transaqueductal “scope-in-scope” endoscopic technique. Twelve endoscopic third ventriculostomies and 1 septostomy had been performed.

Results. Shunt placement was avoided in all patients. There were minimal peri- and postoperative complications. The mean duration of follow-up was 22.3 months (range 3–41 months). All patients had an improved clinical outcome. Follow-up neuroimaging revealed no residual lesion and a decreased ventricle size in all patients.

Conclusions. The present series of patients with fourth ventricular NCC is the largest in the existing English-language medical literature. Endoscopic fourth ventricular cysticercal cyst excision along with internal cerebrospinal fluid diversion via endoscopic third ventriculostomy is an effective alternative to open microneurosurgical procedures and avoids shunt placement and its related complications. (DOI: 10.3171/PED-08/01/035)

KEY WORDS • cyst • endoscopic third ventriculostomy • fourth ventricle • hydrocephalus • neurocysticercosis • pediatric neurosurgery

EUROCYSTICERCOSIS is the most common parasitic infestation of the central nervous system worldwide. It is quite prevalent in India and Latin America. Brain parenchyma is most likely seeded through hematogenous dissemination. The ventricular system, subarachnoid space, and basal cisterns are then seeded via the choroid plexus. Hydrocephalus develops in approximately 30% of all patients with NCC because of obstruction by intraventricular or subarachnoid lesions.

Intraventricular NCC, the presence of Taenia solium cysts in the cerebral ventricular system, occurs in 7–30% of patients with NCC. The disease has a predilection for the occipital horn of the lateral ventricles and the fourth ventricle. The cyst tends to migrate to the fourth ventricle because of gravity and CSF flow patterns. Intraventricular NCC can cause noncommunicating hydrocephalus by obstructing the CSF pathway. Alternatively, the ependymitis caused by intraventricular NCC can lead to communicating hydrocephalus. Life-threatening acute intermittent hydrocephalus (Brunn syndrome) can occur due to cyst-inducing intermittent CSF obstruction from a ball-valve mechanism. However, abrupt permanent obstruction can cause sudden death due to brain herniation.

Intraventricular neurocysticercal cysts occur singly or in multiples and frequently coexist with parenchymal and subarachnoid cysts. Note that a cyst in the fourth ventricle tends to be solitary, without accompanying parenchymal cysts. There is still no consensus regarding optimal treatment strategies in patients with intraventricular NCC. Various therapeutic modalities include antihelminthic medication, microneurosurgical removal, ventriculoperitoneal shunting, and endoscopic management. In patients presenting with acute hydrocephalus, surgery is the only option.
peritoneal shunts carry the risk of infection, shunt malfunction, and cyst migration. Microneurosurgical approaches can be technically demanding and associated with various complications. Endoscopic management of intraventricular NCC has shown encouraging results, however, the literature regarding the use of this modality in the treatment of fourth ventricular NCC is scarce.

We report on a series of 13 patients with fourth ventricular NCC who underwent transventricular, transaqueductal “scope-in-scope” endoscopic excision at a tertiary care neurosurgical center.

Clinical Material and Methods

Patient Characteristics

We retrospectively analyzed the records of 13 patients (6 male and 7 female) with fourth ventricular NCC who were treated endoscopically between June 2001 and December 2006. The mean patient age was 25.7 years (range 4–55 years). All the patients had presented with headache. Other presenting clinical features included vomiting (69.2%), visual deterioration (46.2%), seizures (23.1%), and vertigo (15.4%). Gait ataxia, diplopia, and hemiplegia were present in 1 patient (7.7%) each. Computed tomography and MR imaging were performed in all patients and revealed a well-defined cyst in the fourth ventricle and parenchyma. In 4 patients, however, there were also associated parenchymal cysts. In 1 patient a cyst was present at the foramen of Monro as well as in the fourth ventricle and parenchyma. The prerequisite imaging for endoscopic excision is a dilated aqueduct and third ventricle.

Endoscopic Technique

All patients underwent transventricular, transaqueductal endoscopic excision of fourth ventricular neurocysticercal cysts. In 12 of 13 patients, ETV was also performed in the same setting for CSF diversion, and in one patient both ETV and septostomy were performed.

A Karl Storz neuroendoscope system was used in all the cases. Patients were placed supine with a neutral head position after intubation. A small right frontal bur hole was made 3 cm lateral to the midline on the hairline (5 cm anterior to the coronal suture). The dura mater was incised in a cruciate manner; the pia mater was coagulated and cut. An endoscopic trochar and cannula were introduced into the right frontal horn. A rigid neuroendoscope (5.5 mm) was introduced into the lateral ventricle and navigated through the foramen of Monro into the third ventricle (Fig. 1A). Endoscopic third ventriculostomy was performed using a 3-F Fogarty balloon catheter. A flexible endoscope (2.8 mm) was passed through the rigid endoscope (scope-in-scope technique; Fig. 1B). The flexible scope was navigated through the dilated sylvian aqueduct into the fourth ventricle. The cyst was grasped using a long, flexible biopsy forceps and removed in toto along with the flexible scope through the rigid scope (Fig. 1C). The scope-in-scope technique was performed in selected cases in which preoperative imaging had revealed a well-defined cyst in the fourth ventricle as well as a dilated aqueduct. Cyst rupture did not occur in any of the patients. The cyst was withdrawn along with the whole assembly of flexible and rigid endoscopes through the introducer sheath.

Results

Postoperatively, 12 patients received albendazole (15 mg/kg/day, twice-daily dosages for 21 days) and steroids. One woman who was 24 weeks pregnant was not given albendazole because of teratogenicity concerns. The mean hospital stay following surgery was 4.7 days, although most patients were discharged on the 3rd postoperative day (Table 1). The mean duration of the follow-up was 22.3 months (range 3–41 months). There was no residual lesion on follow-up computed tomography or MR imaging, and the ventricle size normalized in all patients. There was no postoperative wound infection, CSF leakage, or meningitis in any of the patients. One patient had an intraoperative bleed, and an external ventricular drain was inserted and removed when the CSF cleared up; the patient was subsequently discharged. In another patient thrombophlebitis developed on the right arm on postoperative Day 1 but resolved by postoperative Day 3. All patients had an improved clinical outcome. In 5 patients, follow-up CSF flow studies were performed to assess flow through the patent third ventriculostomy.

Illustrative Case

History and Examination. This 13-year-old girl presented with a 3-month history of intermittent headache, vomiting, and vertigo associated with blurred vision for 2 months. Bilateral visual acuity was 6/18 on the Snellen chart, and fundus examination revealed bilateral papilledema. Magnetic resonance imaging of the brain (Fig. 2A and B) revealed moderate hydrocephalus with fourth ventricular dilation and
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**TABLE 1**

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs)</th>
<th>Sex</th>
<th>Lesion Site</th>
<th>Surgery Performed</th>
<th>Duration of Postop Stay (days)</th>
<th>Periop &amp; Postop Complication</th>
<th>FU Duration (mos)</th>
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<td>4th V, parenchymal</td>
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<td>CE + ETV</td>
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<td>17</td>
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<tr>
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<td>4th V</td>
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<td>M</td>
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<td>F</td>
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* All patients had an improved outcome, and a decreased ventricle size and no residual lesion appeared on follow-up imaging in all patients. Abbreviations: CE = complete endoscopic cyst excision; FOM = foramen of Monro; FU = follow-up; 4th V = fourth ventricle.

† External ventricular drainage was performed in this patient, and the drain was removed after the CSF was clear. He was discharged in a stable condition after suture removal. At the 18-month follow-up, he was asymptomatic.

‡ Patient had mild fever (100°F) on postoperative Day 1 due to thrombophlebitis in the right arm, which resolved by the 3rd postoperative day.

a cystic mass with features suggestive of fourth ventricular NCC.

**Treatment.** Endoscopic transaqueductal excision of the fourth ventricle neurocysticercal cyst and ETV were performed while the patient was in a state of general anesthesia. Intraoperative findings consisted of a loosely adherent white cyst impacted in the fourth ventricle. Posttreatment Course. The perioperative period was uneventful. The patient was relieved of headache and vomiting after surgery and was discharged on the 3rd postoperative day. Albendazole (400 mg twice a day for 21 days) was prescribed. The sutures were removed on the 7th postoperative day in the outpatient department. Postoperative MR imaging showed resolution of the hydrocephalus and no evidence of NCC (Fig. 2C and D). The patient was asymptomatic at the 6-month follow-up, and her extraocular movements were normal.

**Discussion**

Nowadays, endoscopic excision of intraventricular NCC and the creation of an internal CSF diversionary channel for hydrocephalus have become the preferred management strategies at various neurosurgical centers having the required expertise.5,6,7,15,22,23 Different endoscopic techniques have been described for excision of fourth ventricle neurocysticercal cysts. Zymbarg and colleagues41 used a rigid neuroendoscope to visualize the aqueduct, and through this device they passed a 6-F catheter across the aqueduct to aspirate the fourth ventricle cyst and retrieved the cyst along with the catheter. Similarly, Husain et al.22,23 used a 5-F angiographic catheter passed through a rigid neuroendoscope to negotiate the aqueduct. In 6 cases in which the dome of the fourth ventricle cyst was visible through the dilated aqueduct from the third ventricle, the cyst was engaged under vision by using the angiographic catheter. In cases in which the cyst was not visible through the rigid endoscope, however, the lesion was engaged and detached blindly by applying gentle negative pressure. This blind technique involves the inherent risk of injury to the periaqueductal region and fourth ventricle walls. In these authors’ series, minimal preaqueductal contusions developed in 3 patients from the negotiation of the angiographic catheter, although these patients had no sequelae. In our technique, a flexible...
used a similar technique in 3 patients to excise cysts along with cyst excision did not require a shunt. This outcome is further supported in a report by Bergsneider et al.10 in which 7 of 10 patients treated with internal CSF diversion along with cyst excision did not require a shunt. Anandh and colleagues13 avoided shunting in 9 patients who had been endoscopically treated with cyst excision and internal CSF diversion. Pnarros and coworkers37 also endoscopically excised fourth ventricle NCC and performed internal CSF diversion procedures in a series of 7 patients, and avoided shunting in all the patients. Shunt placement was also avoided by Husain et al.22,23 in all cases of third and fourth ventricular neurocysticercal cysts by performing ETV.

Other advantages conferred by neuroendoscopy, because it is performed through a small frontal bur hole incision, include less intraoperative time and hence reduced surgical stress. In our series most of the patients were discharged on the 3rd postoperative day following endoscopic surgery, which seems to provide an economic benefit.

It is also important to remember that despite its many advantages, neuroendoscopy has some limitations even when performed by experienced hands.3,7,33 In a patient with severe ependymitis and dense adhesions, endoscopic cyst excision can be difficult and hazardous. Intraventricular bleeding is another potential complication. Although most of the hemorrhage stops through copious irrigation, sometimes it can be difficult to control.

Conclusions

Endoscopic fourth ventricular cysticercal cyst excision along with internal CSF diversion by performing ETV is both a safe and effective alternative to open microsurgical procedures and avoids shunting and its related complications in these patients.

References

Endoscopic excision of fourth ventricular neurocysticercosis


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